TPRS Quarterly Report

The official journal of the leading regional amateur radio digital communications organization of the Americas

May 2001

Published by the Texas Packet Radio Society · Volume 15, Issue 4

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President's Report

President's Report
Tom McDermott, N5EG

Hamcom 2001

Time for Hamcom has arrived - this year it will be held on Friday, Saturday, and Sunday, June 8, 9, and 10th at the Arlington Convention Center. TPRS will not have a booth this year, but we will be presenting a full set of digital programs on Saturday. The TPRS annual meeting will be held on Saturday after the programs. We have openings for 3 director positions this year, and will be voting for these directors. This year's technical program will be held in meeting rooms 2+3+4. The agenda is:

Saturday, June 9, 2001

9:00 - 10:00 What's new in APRS - Guy Story, KC5GOI

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TPRS Quarterly Report

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(Continued from page 1)

The Automatic Position Reporting system (APRS) allows generating automatic position reports via amateur packet radio. In the last year a new public specification for APRS was produced, adding and documenting a large number of new features for APRS. These add a significant number of new capabilities to APRS, such as nation-wide short messages and pages, Internet-enabled group tracking, etc. Guy will discuss the basics of APRS, some of the new features, and how you can setup your own APRS station. Guy is an engineer specializing in RF emission and compliance testing.

10:00 - 11:00 Ham Radio applications of the low-cost PIC series of microprocessors - Steve Bible, N7HPR

The PIC series of microprocessors are very popular in many different Ham Radio applications, from radio, to controllers, rotators, weather stations, CW keyers, and packet radio. Steve has been a very popular speaker on this subject at numerous TAPR meetings, and several of the ARRL Digital Symposiums. Steve will talk about how you can use the PIC to provide a simple, low-cost, yet powerful tools to solve many homebrew problems, and will show you where to find development tools, data, etc. on the web. Steve is an application engineer with Microchip, Inc. in Phoenix, Arizona and has developed and sourced many projects for TAPR using the PIC parts.

11:00 - 12:00 Digital HF modes using the soundcard in your PC - Tom McDermott, N5EG

A new generation of powerful HF digital modes has sprung up in the last year -

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(Continued from page 2)

PSK31, MFSK16, Throb, and Slow-Scan that use the soundcard in your PC for I/O, and use the processor in your PC to do all the digital work. Tom will discuss these new modes, how they work, and what they do. These programs use the sound card that exists in your PC, so you don't need to buy new hardware to use them. More importantly, the software is FREE! Tom will give you pointers to the web sites containing this free software, and demonstration of the programs themselves. Tom is VP, Technology for Chiaro Networks.

12:00 - 12:30 Compact FLASH II - John Koster, W9DDD

TAPR has come out with several new kits for your PC. John will talk about the new compact FLASH cards, and how you can use them to replace the hard-drive in your PC. This works especially well for packet nodes, servers, etc. that are subject to hazardous environmental extremes. John is in engineering in environmental controls, and has been secretary of TAPR for many years.

12:30 - 1:00 Annual Business Meeting, Texas Packet Radio Society

Spread Spectrum Update

There's been a lot of progress on the digital part of the spread spectrum radio, but none on the RF part. The current status of the digital board is:

- Code for the transmit side of the FPGA has been debugged, and the part is sucessfully performing 2x interpolation, and root-raised-cosine filtering along with timing chain generation for the DACs. A lot of the debugging is done with a raised-cosine filter because it is so much easier to see what's happening with an oscilloscope when the signal is passed through a wider bandwidth filter.
- The Tranmsit DAC converter is generating baseband I- and Q- signals. The FPGA and TxDAC interpolators are working, and we are generating a baseband 4PSK transmit constellation. The FPGA and the TxDAC each upsample by 2x and interpolate the transmit I- and Q- waveforms. This 4x oversampling makes the design of the analog reconstruction (anti-aliasing) filters much simpler. The analog reconstruction filters have been checked out and fixed.
- The HDLC and Viterbi decoders have been debugged, and are generating properly coded data to the TxDAC. Software erorrs for the serial channel ,the HDLC channel, and the SPI interface have been identified and fixed.
- The analog filter and buffer/driver stages have been debugged and gotten operational. Additionally, a loopback board has been built, and we able to loopback the transmit analog I- and Q- baseband data streams from the transmit to the receive side of the digital board (as analog signals).
- The receive analog buffers, and the I- and Q- analog-to-Digital converters are working, and appear to be properly digitizing the baseband analog signals.
- We are now just starting the checkout of the digital Costas loop demodulator circuitry and associated FPGA RX code.

We had conference calls in March and April to go over status, changes, PC board mods, etc. It should be posted to the TAPR web page as the web master gets time. John Koster came over and took some digital photos of the transmit waveforms, and the 4PSK

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Digitized by the Internet Archive
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https://archive.org/details/texaspacketradio00unse

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transmit constellation. These were taken before several of the analog driver problems were fixed, and now the constellations are even cleaner than those in John's pictures.

Several members of the design team continue with increased workloads at their paying jobs, and this has made getting enough time to work on the project very difficult.

-30-

MMTTY Software

Mako, JE3HHT has released yet another FREE software packaged based on the soundcard bundled into most PC's nowadays.
This package sends and receives SLOW-SCAN television pictures. The user interface for MMSSTV is different from Mako's other digital programs (MMTTY) in that it deals with analog pictures — but other than that, it will look familiar to those who have used his RTTY software.

The software uses the soundcard to capture and digitize the SSTV analog wveform. Then it uses the 486 or Pentium processor to perform digital signal processing on the signal. Mako's software contains a real-time frequency spectrum display, which makes it easy to locate the 1200 Hz. SYNC tone, and properly adjust the frequency of your receiver to correctly align it.

The program contains the usual transmit, receive, and history buffers, and allows taking BMP or JPEG picutes, and superimposing large block text onto it (for your callsign,

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Texas Packet Radio Society, Inc.

TPRS was founded in 1985 and is an educational, public service, and scientific research non-profit corporation. Texas Packet Radio Society goals are:

1- design and research amateur radio packet networks
2- provide education in the area of general packet usage

To accomplish better communications in the region, TPRS has been organizing statewide working groups to cover various networking topics. The current working groups are the Mailbox/BBS Group, TCP/IP Group, and the TexNet Support Group. TPRS hopes that these working groups will help promote information exchange in their respected areas in Texas. New working groups are formed as needed to provide channels for discussion and to help provide direction for that area of digital communications. Anyone can participate in a working group; TPRS membership is not required.

TexNet

TPRS has established a digital packet network protocol, a standard hardware package for the network nodes, and software modules that implement the TexNet network.

The basic design philosophy of TexNet is an open, inexpensive, multi-resource, high speed 'backbone' with access through multi-connect capable local nodes. On the high speed side, TexNet is a 9600 baud network system. For local access, compatibility with the typical 2 meter AX.25, 1200 baud, AFSK/FM station is the operational norm. Other baud rates and modulation techniques can be supported on the primary user port or secondary port. The system is totally compatible with both versions of the AX.25 protocol specifications for user connections. With these general specifications, TexNet has been designed and tested to enable all users to take advantage of this high speed, full protocol protected packet network system.

Each node offers, in addition to TexNet access, local area digipeater service, 2 conference bridges for full protocol protected roundtable or net operation, a full mult-connect, multi-user mailbox system, a local console for installation and maintenance setups, a debugger module for long distance and local software monitoring,and an interface for a weather information server for regional weather information, if available.

The NCP-PC (TexNet for PC) creates a direct interface to the PC platform. The Z80 based PC card supports 4 channels for communications. This co-processor approach allows the AX.25 and TexNet-IP to run on the card without affecting the PC. This allows the full power of the PC to be used for network applications. The versatility of this board is only now being developed and applications are endless.

The TexNet Network

The Texas TexNet network system has been operational since October 1986. When fully operational, the network reaches from the border of Mexico to Missouri. Use of the Texas TexNet system is open to all amateur operators. TPRS has been coordinating the installation of the Texas TexNet system. Further expansion of the system depends entirely upon the amateur community.

INFORMATION

TPRS is interested in spreading our information and research efforts as widely as possible. We want other groups involved with packet efforts to get in contact with us. We will provide information for those amateur packet groups that are interested in this system for their areas. If you would like more information concerning TPRS or TexNet, please drop a letter to:

Texas Packet Radio Society, Inc.
P. O. Box 50238
Denton, Texas 76206-0238

TPRS MEMBERSHIP

TPRS membership is widespread with most members located in Texas, but members are located in other states and in foreign countries. Membership is open to any interested person. If you are interested in becoming a member and receiving the TPRS Quaterly, please send your name, address and call with membership dues of $12 per year. A membership application is available

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etc.). the program automatically recognizes about 12-15 different SSTV modes, selects the decode mode, and aligns the vertical sync to the top of the receive window.

Controls for adjusting the sampling rate of the soundcard (which affects the 'slant' of the received image) are provided.

MMSSTV can be downloaded free from the http://yahoo.groups.com website. It's in the MMSSTV group. You need to register to use yahoo.groups.com, but it doesn't cost anything. The current version of MMSSTV is 1.0, which I loaded onto a 400 MHz. Pentium 2 laptop running WIndows 98, and with a 16-bit soundchip that is absolutely not Soundblaster compatible, and had no problems - it worked flawlessly the first time.

Wireless LAN resources for Linux

Jean Tourrilhes

This article is reprinted with the permission of the author. It is continued from part 5 in the February 2001 issue of the TPRS QR.

Wireless Extensions for Linux

Jean Tourrilhes

23 January 97

A Wireless LAN API for the Linux operating system.

3.7 Digital radios and changing the protocol

One question popping up in my mailbox is the ability of doing protocol `X' (TDMA, Wireless ATM) with device `Y' (a well known Wireless LAN). A variant of this question is people trying to implement a specific scheme or optimisation in the 802.11 protocol.

This is usually not possible. As we have seen above, most of the MAC protocol is actually embedded in the device and only a few non performance critical functions are handled by the driver on the host. Usually, manufacturers don't tell you how to reprogram the firmware of their devices, but even if it was possible, it would not be enough.

The very low part of the MAC protocol, which is time critical, is implemented in the baseband ASIC, so quite a challenge to change. For example the carrier sense and MAC acknowledgement need reaction in the order of a dozen microseconds, so are prime candidate for the ASIC. Unfortunately, these are precisely the functions that those people want to change.

In fact, many people have been thinking of universal radios, which can be simply reprogrammed to receive (and transmit) any radio standard. The main idea is having a big block of reprogrammable logic on the card and to download a new configuration for each protocol that the system wants to use, making it a fully **digital radio**.

To achieve that goal, we need to go one step further down, and be able to adapt to any modulation and bit rate. Most implementations of common Wireless LANs use fixed analog components in the modem, so are not suitable. So, a digital radio needs to digitise (with a fast AtoD) the whole bandwidth and to feed that the a fast super DSP or EPLD (Electric Programable Logic Device, like a Xilinx or Altera) and to work entirely in the digital domain to demodulate (and modulate) the

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signal. Unfortunately this is not really cost effective and doesn't work that well at the frequency we are talking about (GHz).

4 The radio modem (physical layer)

This section of the document deals with all the issues related to the physical layer (bottom of the pile, OSI wise :-), or in our case the radio modem.

4.1 ISM frequency bands (900 MHz & 2.4 GHz)

In every country, the use of the radio spectrum is **regulated** by some organisations. This is the *FCC* for North America and the *ETSI* for Europe. These regulators define the allocation of each radio frequency bandwidth : for TV and radio broadcasting, for the telecommunication operators, for the army... Usually, to use a frequency band, you must negotiate with these bodies, register your architecture and buy the right to use the frequency.

These organisations, aware of the prospects of local radio communications for individual users, have allocated some specific frequency bands to be used in a more flexible way. The oldest and most commonly used ones are located at 900 MHz and 2.4 GHz and called the **ISM bands** (*Industrial, Scientific* and *Medical*). The main characteristic of these bands is that they are **unlicensed**, this means that the user is free to use them without having to register or to pay anything (apart from the radio hardware).

Of course, to avoid abuses, these organisations have imposed a set of rules for these frequency bands and only the products certified to conform to those rules are allowed to emit in the bands. These rules specify at least the maximum power transmitted in the band and the out of band emissions (to not pollute adjacent bands). The ISM bands rules specify as well that **Spread Spectrum** has to be used (either *Direct Sequence* or *Frequency Hopping*, see chapter 4.3), and how the channels are defined, to allow the peaceful cohabitation of different systems (that's the theory).

The Spread Spectrum rules mandate *Direct Sequence* systems must spread their signal at least 11 times, and that *Frequency Hopping* systems stay on a channel a maximum of 0.4 s and use 75 channels at minimum in each 30 s period. But, don't trust me, check the exact wording of the rules...

These rules may vary depending on the country : the FCC allocates both the 900 MHz and 2.4 GHz band with 1 W maximum power, whereas the ETSI allocates only the 2.4 GHz band with 100 mW maximum power (900 MHz is used for GSM cell phones in Europe). The 2.4 GHz band is available worldwide and the regulations are mostly compatible between the different authorities (usually 80 MHz of bandwidth between 2.4 GHz and 2.48 GHz). The main exception is Japan which has some additional constraints.

The Spread Spectrum rules originally allowed around 2 Mb/s maximum bit rate (both FH and DS), but the Direct Sequence people managed to find a loophole and now offer 11 Mb/s systems (see chapter 4.7.3).

Because these bands are "free", they may be heavily **polluted** by other unlicensed systems. The 2.4 GHz band also suffers from the microwave oven radiations (this explains why it was given for free).

Please note that the regulation for unlicensed bands is quite different from the bands reserved for radio amateurs (HAM). HAM people are not happy because their regulations

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are much more strict (they have to pass an examination including morse code and follow stricter etiquette) and the bandwidth available to them much more scarce.

4.2 5 GHz frequency bands (HiperLan and UNII band)

The 5 GHz unlicensed bands are another very complicated story.

ETSI was the first to open the 5 GHz band, and so far, the 5.2 GHz band is dedicated to **HiperLan** (see chapter 6.3), and the 5.4 GHz band reserved for **HiperLan II** (alias BRAN, see chapter 6.4). As they have done for *GSM* and *DECT*, only systems that fully conform to those standards (Phy and MAC) may operate in the band.

In the States, the FCC has allocated the band between 5.2 and 5.8 GHz (**UNII band**) with some very liberal rules (no spread Spectrum mandated, no channels allocated). To limit systems, they have introduced complicated power rules, making the use of around 20 MHz bandwidth optimal (system using less bandwidth can transmit less power, system using more bandwidth don't get more power), and divided the band in 3 chunks, for low power systems (5.2 GHz), medium power (5.4 GHz) and high power (5.6 GHz). Some people have tried to come up with some "etiquette" for the UNII band (stricter set of rules) but they couldn't accommodate the conflicting requirement of all parties.

In the 5 GHz band, because of the availability of more bandwidth, higher speed are possible (10 to 40 Mb/s). But, operating in a higher frequency band increases the noise level, obstacles and walls are more opaque to transmissions (see chapter 4.8.4), and a higher bit rate require more SNR (Signal Noise Ratio - see chapter 4.6.4), which means a reduced range compared to 2.4 GHZ products, which is bad news.

In summary, in Europe it's HiperLan or nothing. In the USA, the low power chunk of the UNII band (5.2 GHz) is likely to be used by 802.11 at 5 GHz (see chapter 6.2) and HiperLan, and people are unlikely to propose yet another standard. The high power chunk will be used by wireless distribution systems, and both type of system will fight for the medium power chunk...

4.3 Spread Spectrum techniques

Spread spectrum is a technique (mainly pioneered by the army) trading bandwidth for reliability. The goal is to use more bandwidth than the system really needs for transmission to reduce the impact of localised interferences (bad frequencies) on the system. Spread spectrum, as it prevents one system to use the full bandwidth capacity, also force independant systems to share the bandwidth (in a mostly fair way). In the 2.4 GHz band, the regulation specifies that systems have to use one of the two main spread spectrum technique : *Direct Sequence* or *Frequency Hopping*.

Which one is better ? This is the main technical war between the radio LAN vendors. Everybody, of course, argue that its own technology is better. For now, no one has come with some decisive arguments about the comparative performance and robustness of these two technologies (estimating performance of radio systems is a tricky job). Of course, comparing products doesn't make sense because the performance of a system depend on many other components (the MAC protocol, the signalling rate), the optimisation chosen (performance versus reliability versus cost) and the actual implementation (hum,

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hum...).

4.3.1 Direct Sequence

The principle of **Direct Sequence** is to *spread* the signal on a larger band by multiplexing it with a signature (the code), to minimise localised interference and background noise.

The system works over a fixed large channel. To spread the signal, each bit of the packet to transmit is sur-modulated by a *code* (a fast repetitive pattern). In the receiver, the original signal is recovered by receiving the whole spread channel (averaging effect) and demodulating by the same code (processing gain). For a 2 Mb/s signalling rate modulated by a 11 chips code (like the Wavelan), the result is a signal spread over 22 MHz of bandwidth.

Any narrowband interferer, because it uses only a small part of the total bandwidth used by the system, will appear much weaker to the Direct Sequence system (I think it will be much clearer if you look at the picture below). Moreover, the demodulator use the same code as the transmitter to match the received signal, which decrease further signals not modulated by the code (this is called the processing gain of the code, 11 chips as used in 802.11 gives in theory a 10 dB processing gain).

Direct Sequence is also the principle used by *CDMA* (Code Division Multiple Access - one of the cellular phone technique), but in CDMA each individual phone channel is given a different code on the same frequency. By having each channel having a orthogonal code and the same received power (so, using power control), it is possible to recover every CDMA channel using its code. The only limit of the scheme is that the noise is proportional of the number of channels (so the degradation with increased capacity is graceful). The configuration also needs to be a star topology (to use power control), which doesn't suit well Wireless LAN.

The spreading with the code produces a faster modulation, therefore a DS modem is quite complicated (it usually require faster circuits and a DSP or equivalent logic for the spreading). One the other hand, the fact of having one single fixed channel (as opposed to Frequency Hopping) eases the task of the higher layers (MAC).

Because it uses a large channel, a Direct Sequence system has only a few channels available in the bandwidth (3 for the *Wavelan* - on different frequencies). Those channels are totally separate (they don't generate interferences on each other). Direct Sequence also offers the possibility to use partially overlapping channels for systems in adjacent areas, increasing slightly the number of channels. But this last solution tends to increase the noise and decrease the performance of the system, because all those systems usually operate with the same code (and not one code per frequency).

4.3.2 Frequency Hopping

Frequency Hopping uses a set of narrow channels and walk through all of them in sequence. For example, the 2.4 GHz ISM band is divided in 79 channels of 1 MHz. Periodically (every 20 to 400 ms usually), the system *hop* to a new channel, following a predetermined cyclic *hopping pattern*.

The system avoids interferences by never staying on the same channel : if a channel is bad, the system might not be able to use it and just waits for the next good channel. As the pattern makes the whole network hop through all the bandwidth available, the system average the effect of bad channels over

TPRS Node Assigments

Official Publication: February, 2000

Subject to Corrections/Additions/Deletions.

X = ACTIVE/COMPLETED
T = ACTIVE/TEST
P = PENDING

Nr	Status	City/Town	Alias	Call	User Port	Remarks
3	X	Dallas	TEXNET	WR5C	145.05	PMS
2	T	Richardson	TESTBED	W9DDD	None	R&D
	T	Richardson	RICH	W9DDD	None	R&D
1	X	Murphy	MURPHY	N5EG	145.09	
5	P	Austin	NWS	Unkn	None	Weather PMS
6	P	New Braunfels	STXWX	N5IUT	145.05	Weather PMS
7	X	Boerne	BOERNE	N5VUO	145.01	
8	X	Geronimo	GERONMO	WB5NSN	145.07	PMS(AKA GERLNK)
9	X	Austin	AUSTIN	WA5LHS	145.07	
11	X	San Antonio	ALAMO	N0CCW	145.09/223.50	
12	X	San Antonio	SALAMO	WA2MCT	None	
13	X	Denton	DENTON	W5NGU	145.03	
14	P	Lubbock	LUBBOCK	KC5KQF	145.05	
15	P	Midland	MIDLAND	WB5RXA	145.05	
16	X	Greenville	GREENVL	K5GVL	145.07	
17	P	Midland	MAFDXC	WF5E	223.58	DXCluster port
19	X	Rockport	ROCPRT	N5JKH	144.99/446.1	
20	X	C. Christi	CORPUS	N5XCH	145.05	
21	X	Pettus	PETTUS	KA5BWL	147.56	
23	P	Lubbock	LBBDXC	KA5EJX		DXCLUSTER
24	X	Austin	AUSDXC	K5TR	144.99	
25	X	Austin	ARESTC	W5TQ	145.73	
26	X	Victoria	VCTRIA	W5DSC	145.01	
27	X	Alice	ALICE	K5DYY	145.07	
28	P	Amarillo	AMARILO	WD5ILA	145.05	
29	P	Abilene	ABILENE	WB5EKW	145.05	
34	X	San Antonio	SANTEX	WB5FNZ	223.58	
42	X	Kingsville	TAMUK	W5ZD	144.91	(aka KINGVL)
43	P	Bryan/CollStn	SBRAZOS	KF5LN	145.05/446.10	
44	P	Bryan/CollStn	NBRAZOS	KG5ZD	446.1	(See Nr 43)
45	P	Fannin County	FANNIN	WB5RDD	145.05	
46	X	Sherman	SHERMAN	WB5CVR	144.91	
47	P	South Dallas	SDALLAS	KF5RN	None	
48	X	Waco	WACO	WD5KAL	145.09	
49	X	Falfurrias	FALFUR	WB5FRO	None	
50	X	Mercedes	VALLEY	W5RGV	144.60	DXCluster port 2
51	X	San Isidro	ISIDRO	K5RAV	None	
52	X	Brownsville	BROWX	K5RAV		NWS node
73	X	Fort Worth	FTWORTH	N5AUX	144.99	
80	T	AOHTST	AUSTIN	WB5AOH	None	R&D AUSTIN
95	T	TNC95	AUSTIN	WB5AOH	None	R&D AUSTIN

TPRS Node Assigments
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Subject to Corrections/Additions/Deletions.
(Continued)

(100-150) Reserved for TexLink Node Usage

Nr	Status	City/Town	Alias	Call	User Port		Remarks
105	X	Floresville	FLORES	WD5DOE	None		
109	X	Refugio	REFUGIO	WB5OLT	None		
118		Moody	MOODY	W5ZDN	440.1		

(151-249) Reserved for Non-Texas Node Usage
(150-159) Reserved for Louisiana

151	X	Lafayette LA	LFTDXC	N5SYF	145.01		
152	P	BatonRouge LA	BTRDXC	N5VWM			
153	X	Maxie LA	MAXIE	K5USL	145.01		
160	X	Ft Gibson OK	FTGIBSN	N5GIT	145.01		
161	X	Muskogee OK	MKOTST	WA5VMS	446.5	PMS	
162	X	Muskogee OK	MUSKOGE	W5EJK	145.09		
164	X	Lincoln AR	FAYETVL	K5VR	145.69		
165	X	Clayton OK	CLAYTON	W5CUQ	145.03		
166	X	Ft Smith AR	FTSMITH	W5ANR	144.91		
168	X	Tulsa OK	NWTULSA	W5IAS	145.03		Temp. Off Air
169	X	Tulsa OK	TULWX	N5WX	NWS WX	Server	
172	X	Okemah OK	OKEMAH	WB5HLR	145.69		
173	X	Choctaw OK	CHOCTAW	K5CAR	145.69		
174	?	Prarie Grove AR	HOGEYE	K5FXB	None		
175	X	Garfield AR	GARFLD	WB2ROC	None		
176	X	Aurora Missouri	OARSMO	K0SQS	145.05		
177	X	Mt Magazine AR	MAGAZIN	KF5XB	144.95		
178	X	Russelville	RSLVL	WB5BHS	UNKN		
179	X	Little Rock AR	LROCK	WB5SQK	144.97		PORT 2
446.50(FUTURE)							
209	T	Little Rock AR	LRTST	KA5SQK	TEST Node		

(250-255) Network Reserved

If you are a TexNet node opearator/owner and have a correction to make to the list, advise to N0CCW@K3WGF.#STX.TX.USA.NOAM, or leave a message for N0CCW on the NDALLAS PMS of TexNet.

TPRS Membership Application

Name ______________________________ Callsign _______________
Address ____
Apt. or Mailstop ____________________
City/State ____
Zip ______________________ E-mail address __________________
Evening Phone ( ) ___________ Work Phone ( ) _____________

Membership is $12 per year. How many years are you paying for? ____

☐ New Member ☐ Renewal

Make check payable to: Texas Packet Radio Society

FOLD HERE

PLACE
STAMP
HERE

____
____
____

ATTN:
Membership

Texas Packet Radio Society
P.O. Box 50238
Denton, Texas 76206-0238

Texas Packet Radio Society, Inc.

Hamcom - June 9th

MMSSTV Slow-Scan Software

Wireless LAN Resources for Linux - Part 6

Be sure to visit the TPRS web page:
http://www.tprs.org
for the latest information on TPRS activities.

A current listing of Packet nodes, frequencies, and networks is located in the **North American Digital Systems Directory (NADSD) on-line at:**
http://www.tapr.org/directory/index.html

Texas Packet Radio Society
P.O. Box 50238
Denton, Texas 76206-0238

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To: